Max-Planck-Institut für Plasmaphysik

Data curation for high Performance Scenarios: Steady-state pellet injection

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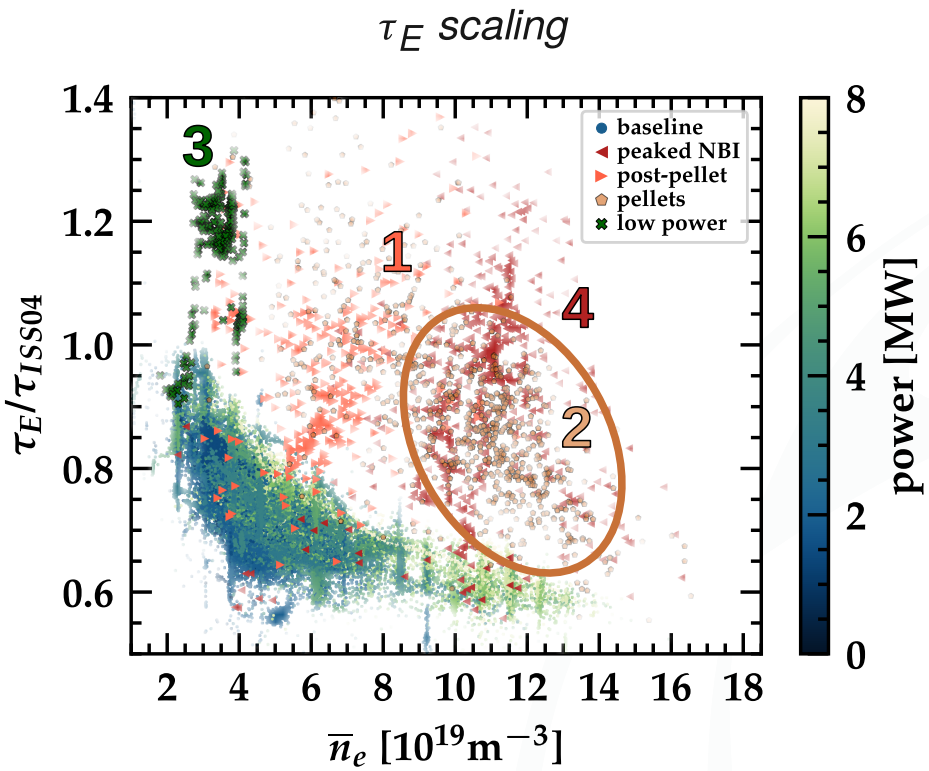
?.?.2026 TG Core Profiles

MAX PLANCK GESELLSCHAFT

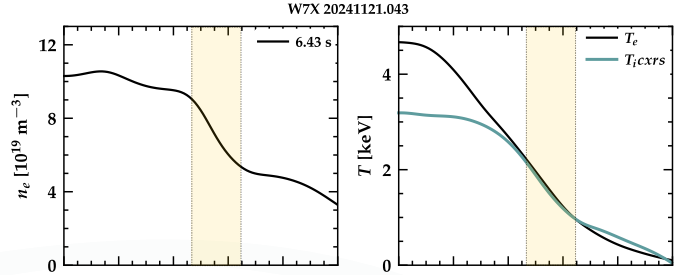
EUROfusion

Reminder: Peaked density scenarios

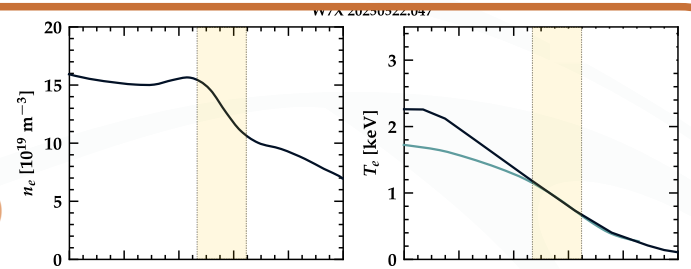
Currently there are 4 main known operational scenarios:
For this presentation, we are looking at #2.



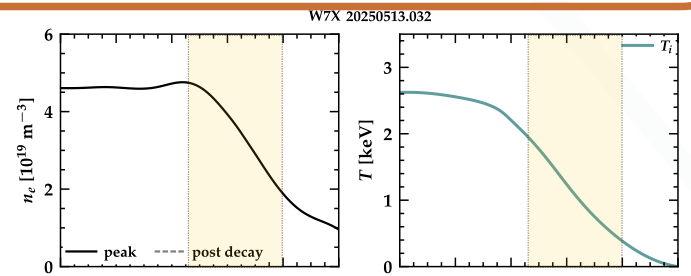
1: Post-pellets



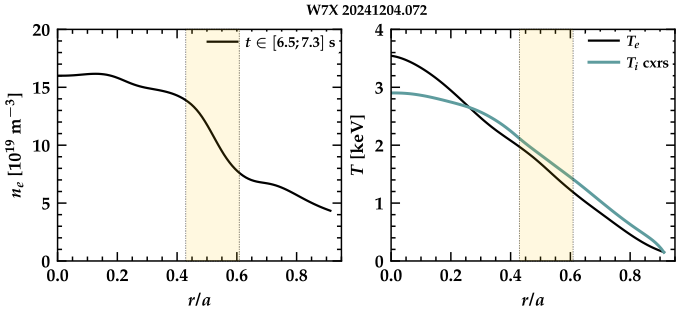
2: 'Steady-state' pellets
(e.g. in press release 2025)



3: Low-power + ?
'intrinsic' peaking

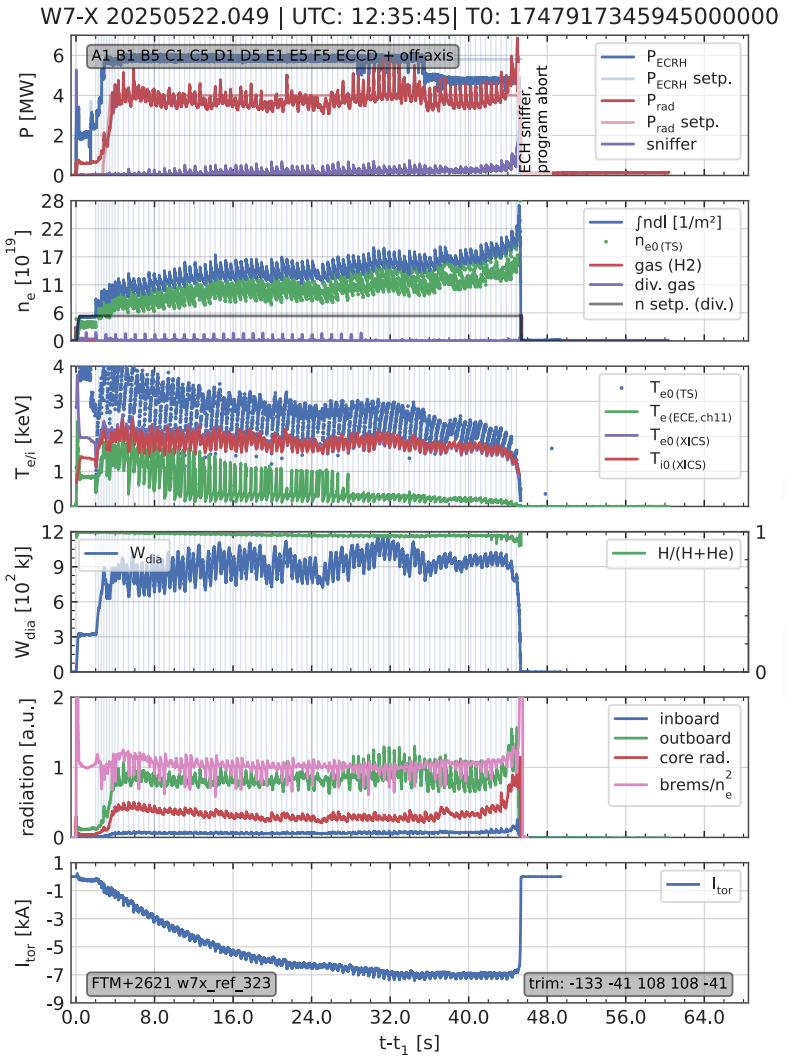


4: NBI + ECRH reintroduction
(e.g. in record n T τ.
+PRL submission)

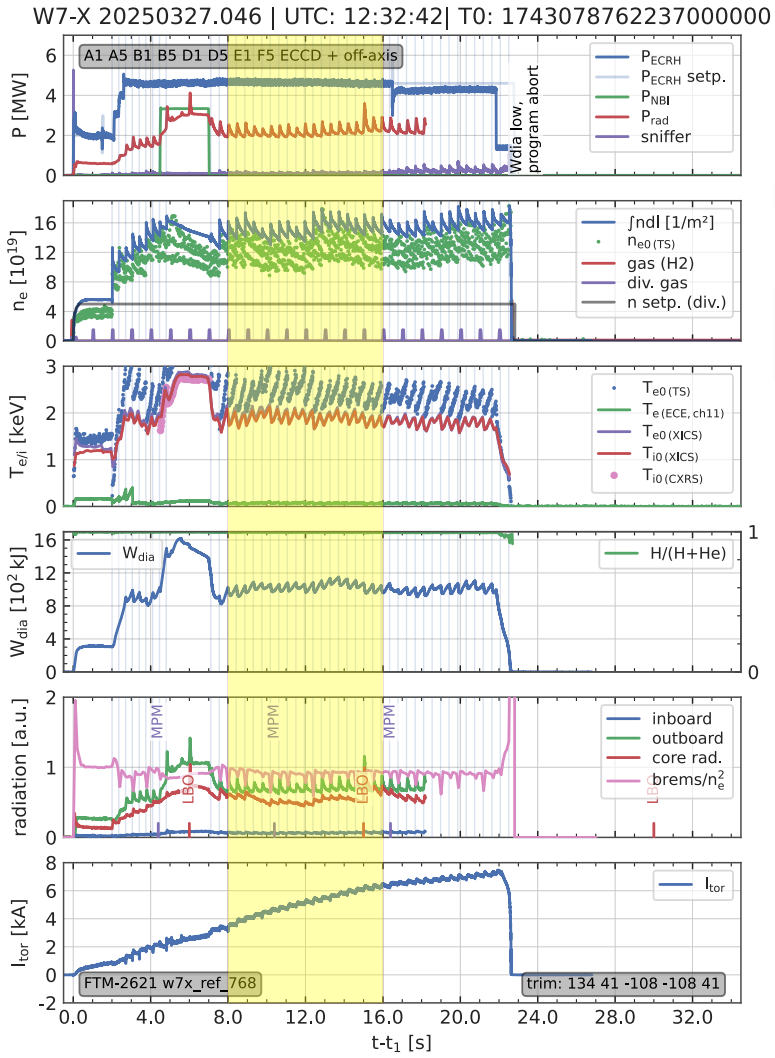


Steady-state pellet injection

Two main candidates looked at so far, we look at the right case as it's more consistent.



20250522.049
40s total,
Intermittent performance
Seeding
Ti = 1.8 keV
f_ren = 0.8
n.T.tau = 0.3

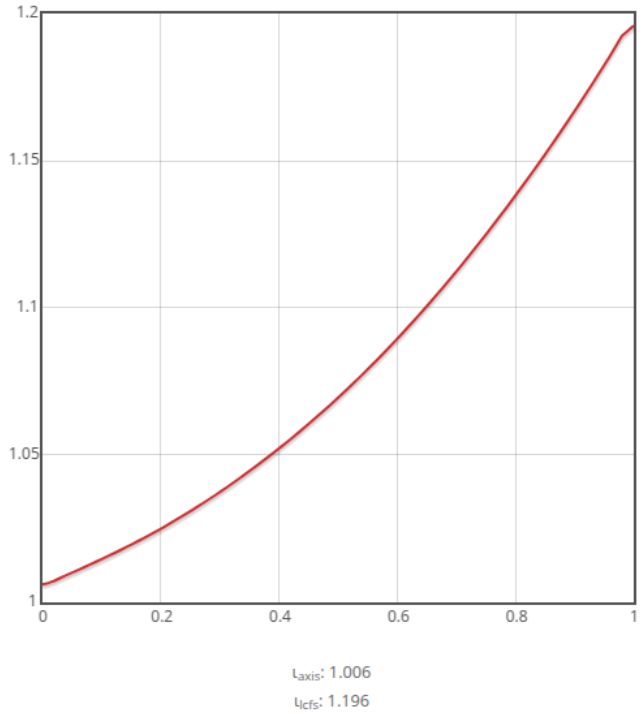


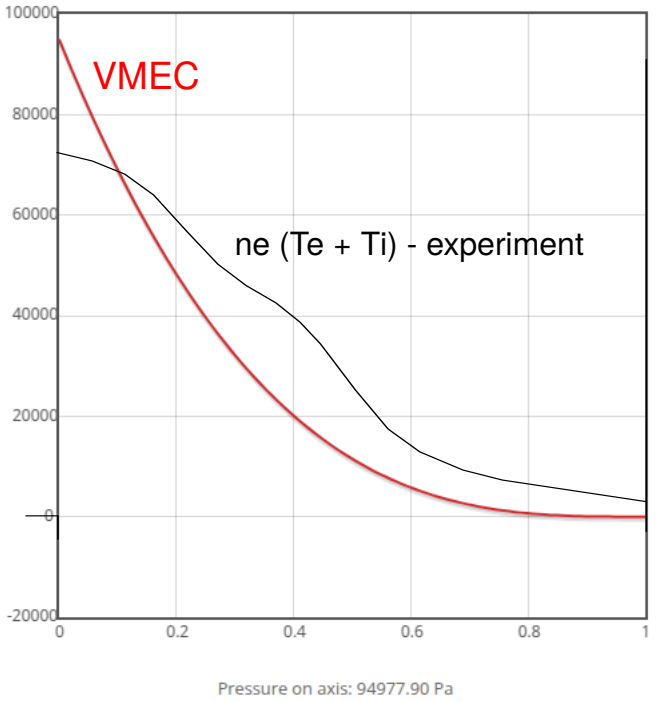
20250327.046
20s total,
8s of quasi-steady-state.
No seeding.
Ti = 1.9 keV
f_ren = 0.9
n.T.tau = 0.5

20250327.046 - Configuration

High-iota "FTM" with B = -2.62T on axis.
During SSPI phase automatic best-fit VMEC from profile cooker is:
boz_FTMpl262_phi_1.721_p0_95.00_ppeak_4.00_Itot_0.00_Ipeak_0.00_v20210122000322

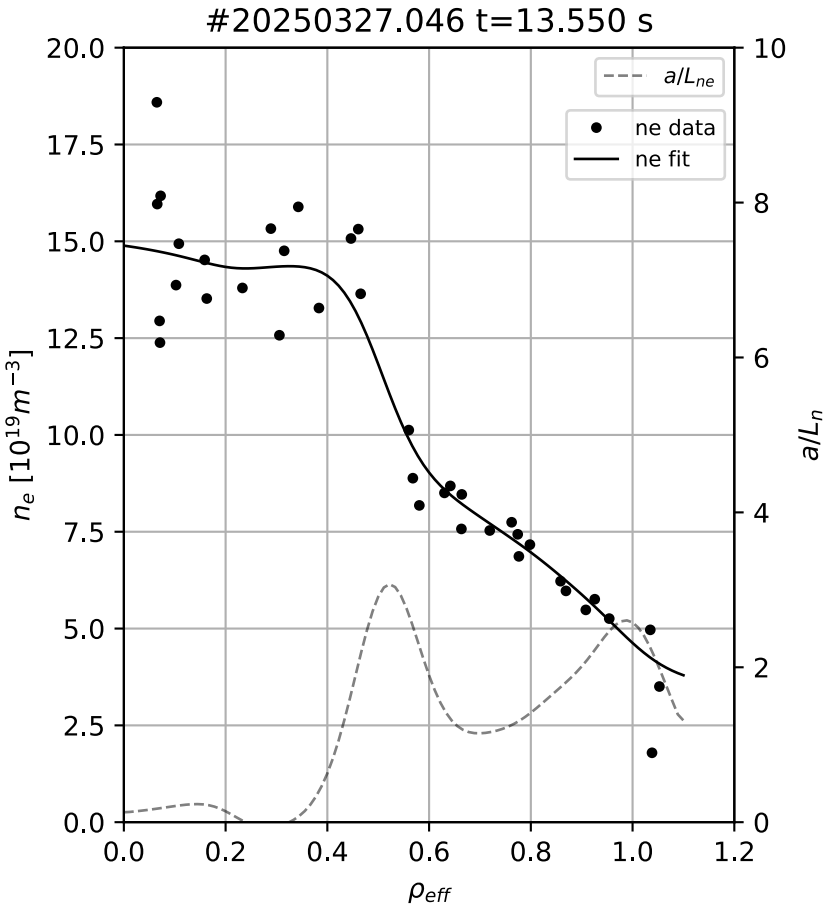
ID is the same on average and at peak and min density.
Plasma current rises from 0 to max 7 kA and is ignored in this VMEC run.

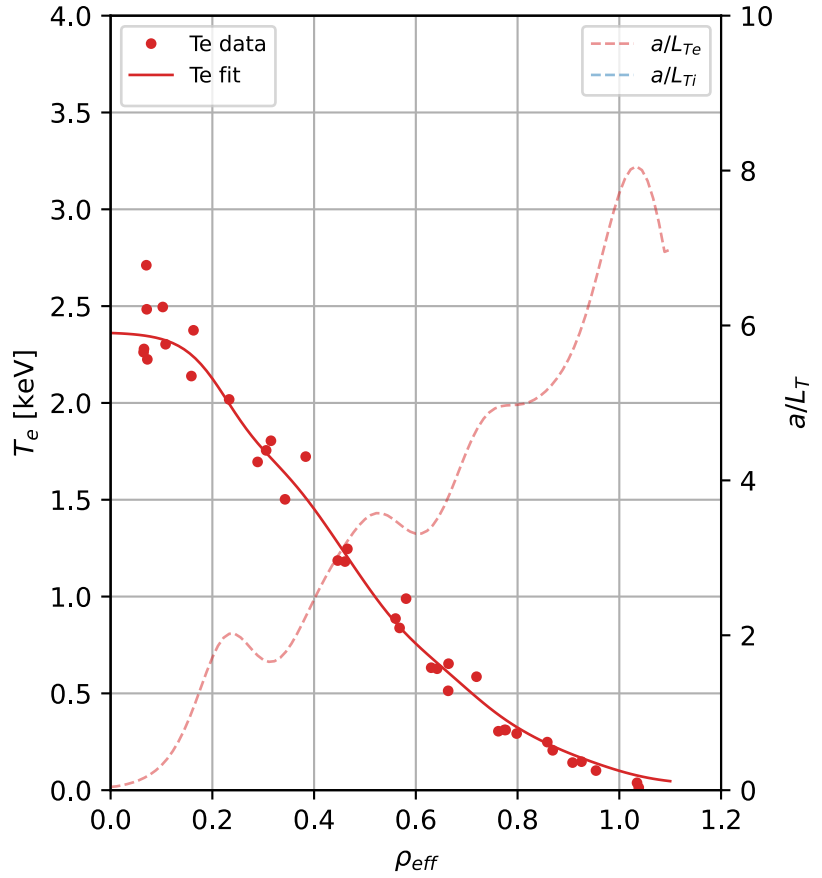




20250327.046 - Thomson Scattering

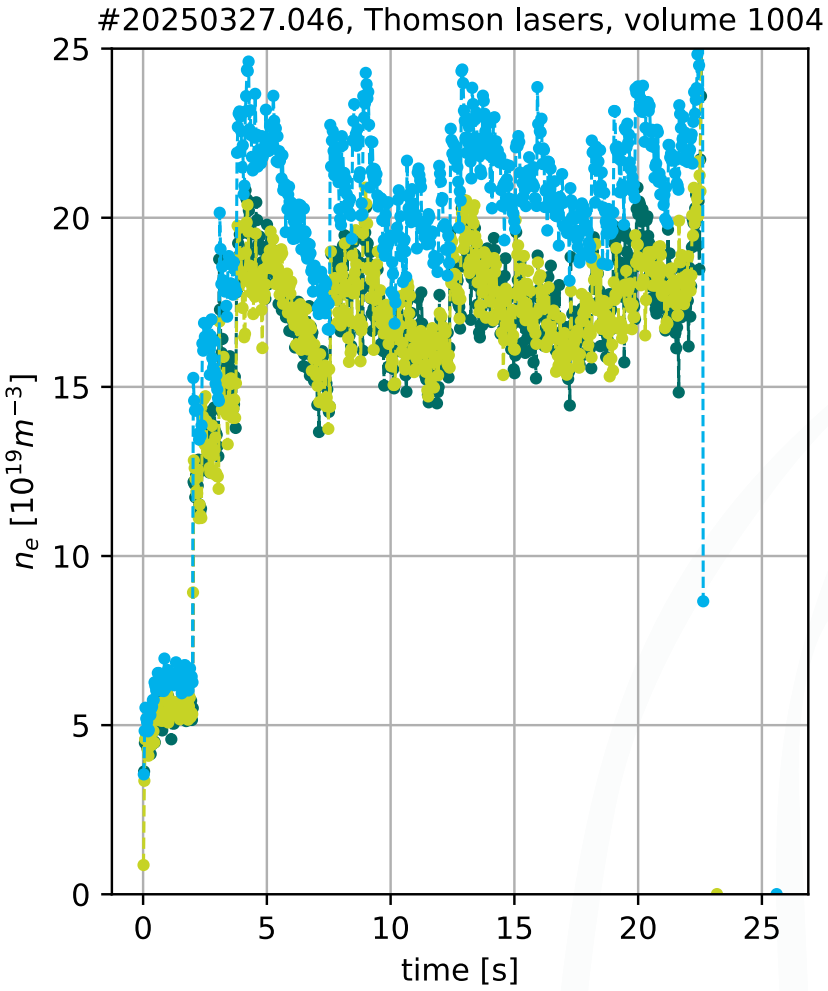
Thomson Scattering is quite good. Individual ne, Te profiles OK.
Very strong gradient at rho~0.5 is not really resolvable. We believe it is at least a/Ln > 5. It could be more.
Points near axis are scattered and different between the two optical systems. Don't trust gradients for rho < 0.2.

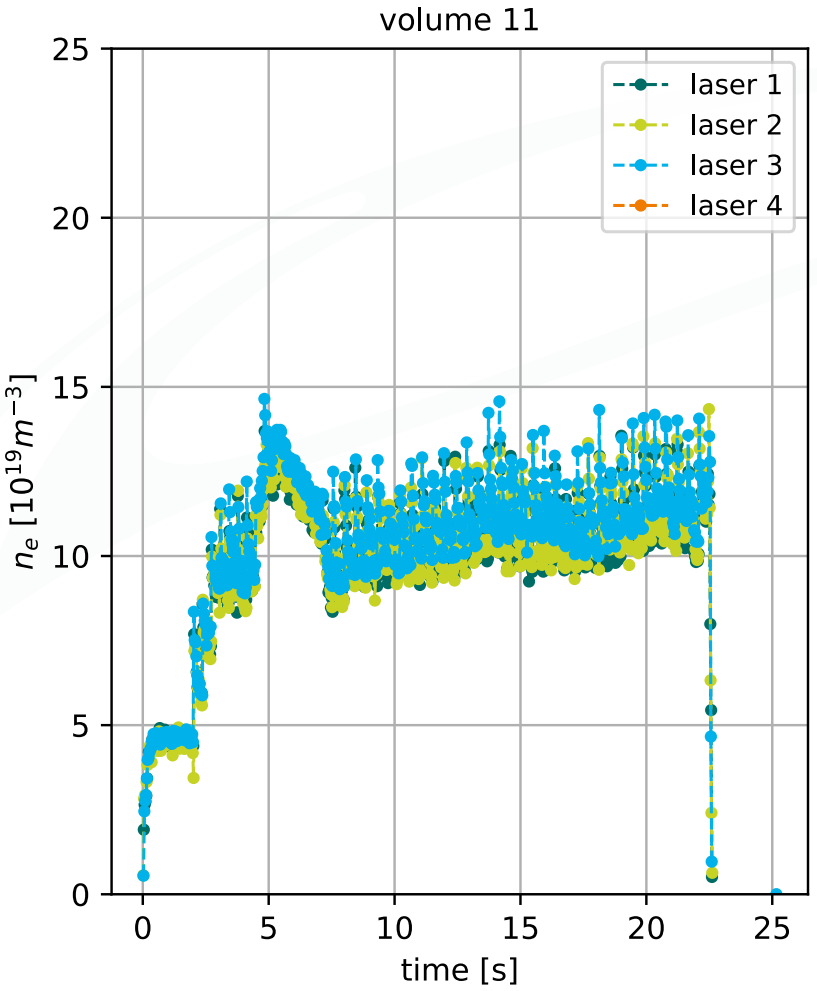




20250327.046 - Thomson Scattering

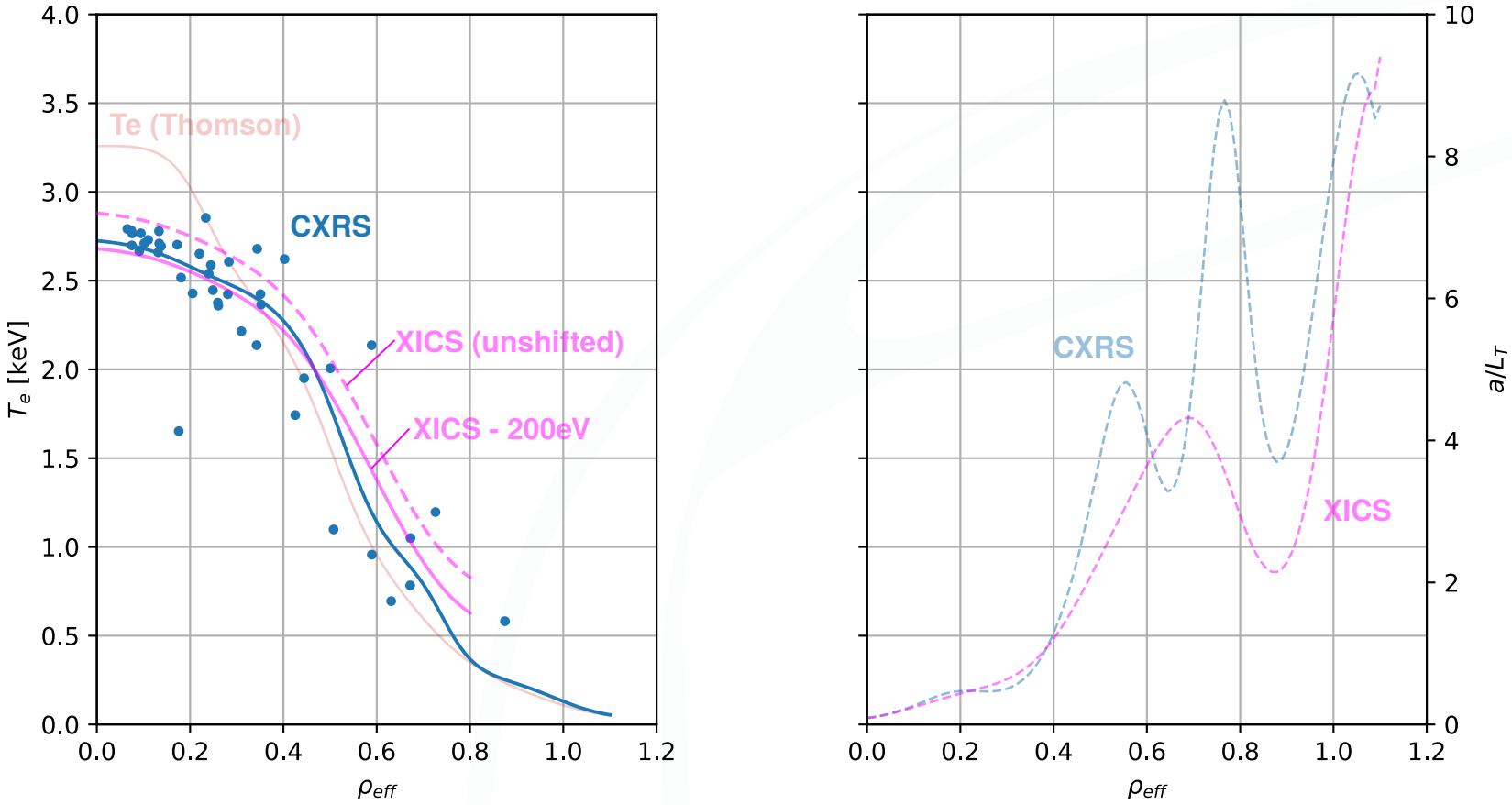
ne profiles are normalised to interferometer. Profile shape from TS varies somewhat between the 3 Thomson lasers: We ignore laser 3 for this shot.





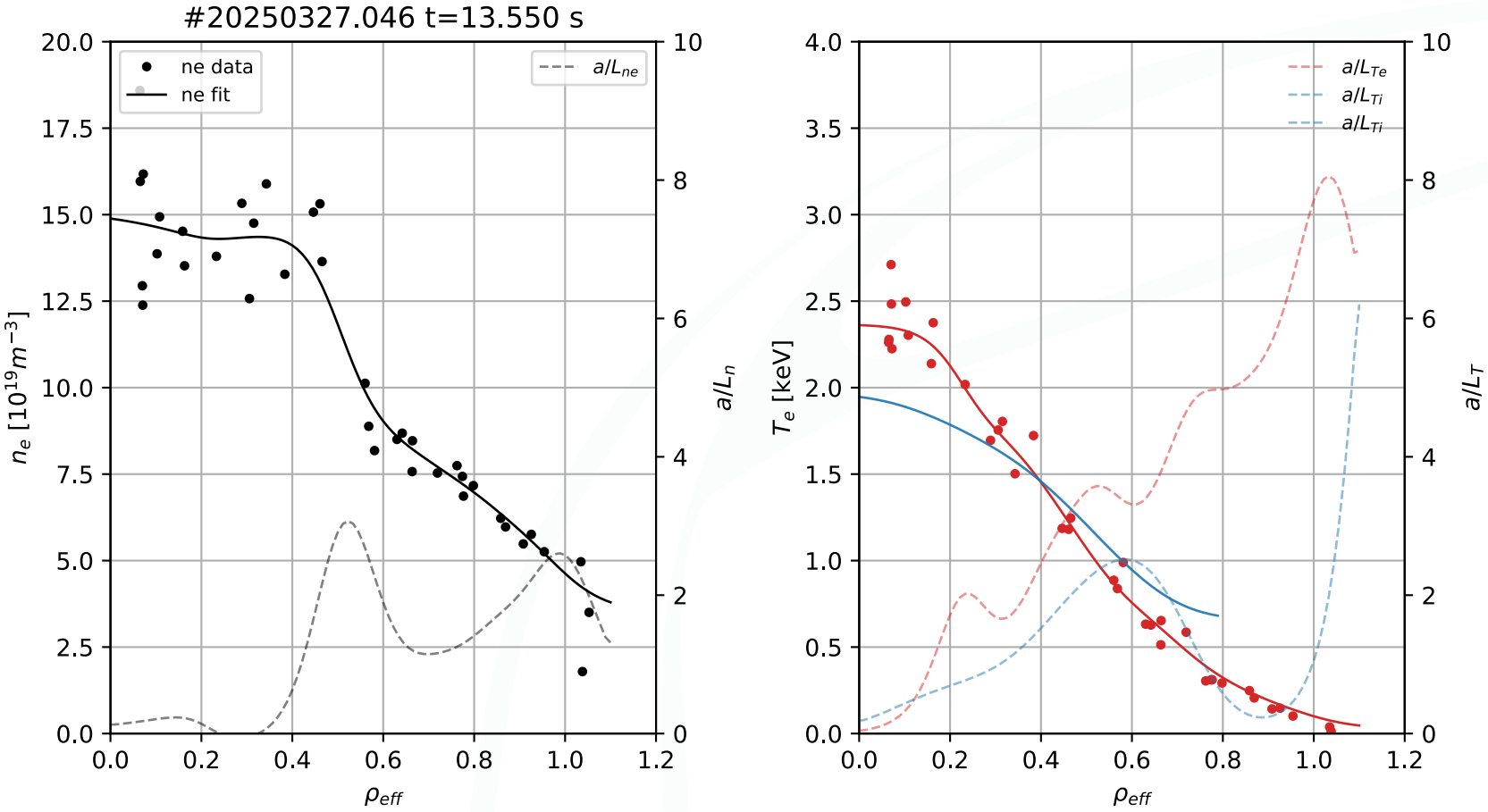
20250327.046 - Ion temperature

Ion temperature only available from XICS during pellets phase (no NBI for CXRS).
During NBI phase near start of shot, XICS is at least 200eV lower than CXRS, as usual (see 10.1063/5.02194690.1063/5.0219469).
Gradients are similar once XICS is corrected.



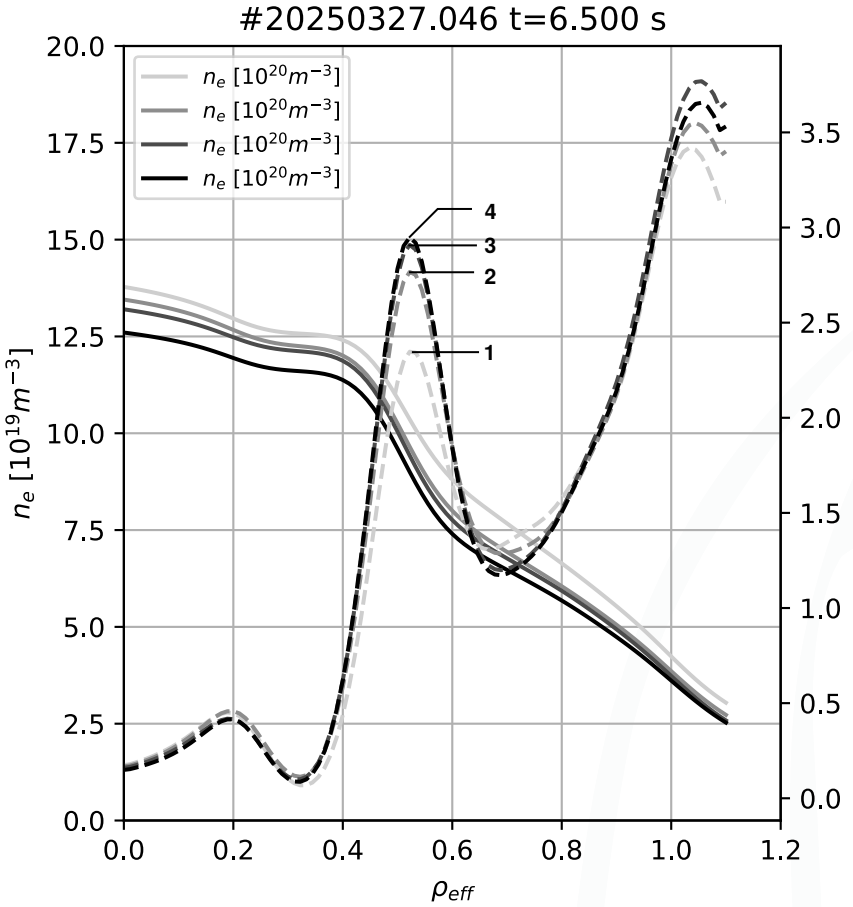
20250327.046 - Ion temperature

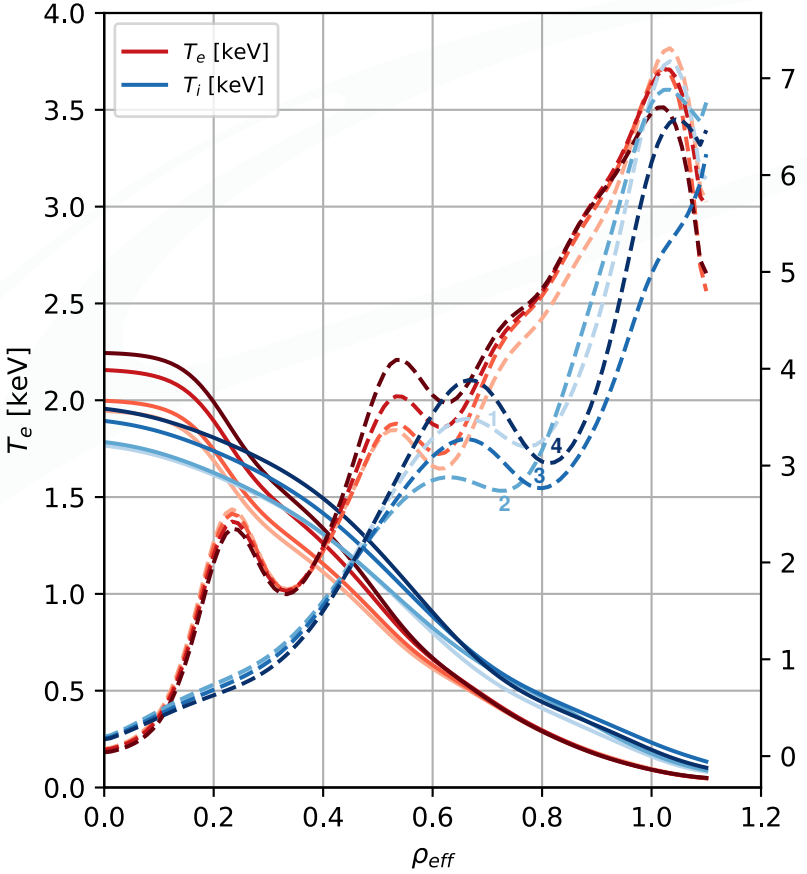
Ion temperature only available from XICS during pellets phase (no NBI for CXRS).
XICS profiles probably give reasonable core Ti, but gradient region seems unlikely to satisfy equipartiton at this high collisionality.
--> Need to check max |Te-Ti| allowed from power balance. In the meantime, use Te profile for rho > 0.5.

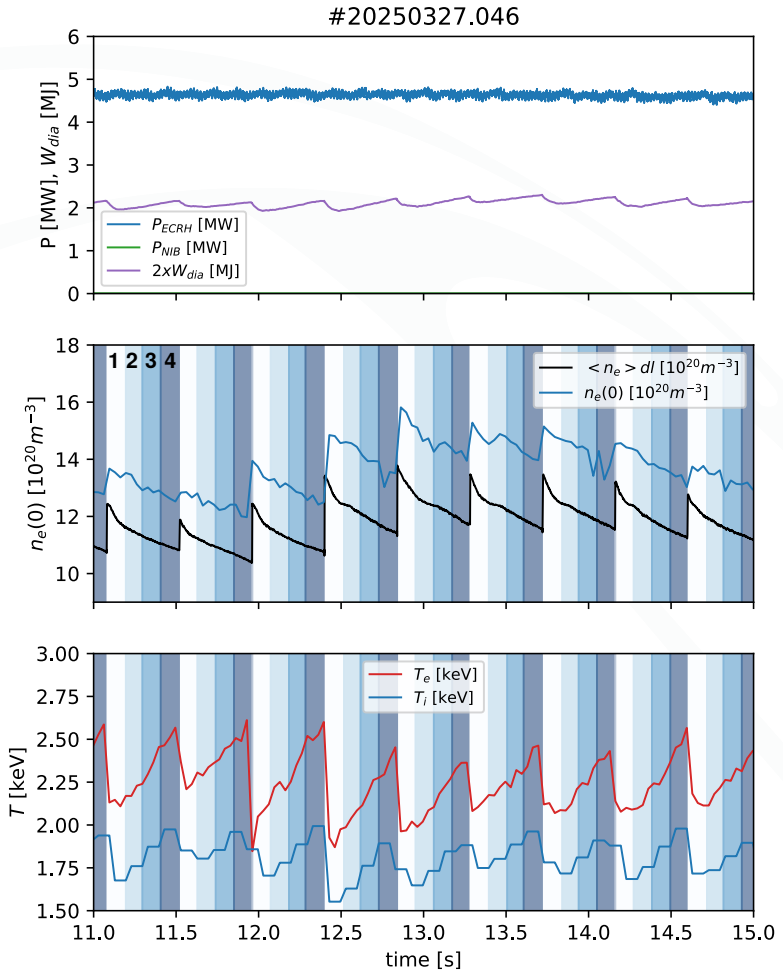


20250327.046 - Pellet cycle

Pellet cycle is relatively stable, and we can bin and average over time since last pellet for better profiles:







20250327.046 - Pellet cycle

The location of peak a/LTe and a/Lne coincide. Probably a/LTI would too if we had the diagnostic resolution.
If we average a wide enough radial region, we can see the dynamics in the gradient plane of the high-gradient region.
Note: This reduces he magntiude of a/L. Also, remember that the ***peak*** a/Ln might be anywhere to the right!